was treated with an IMRS plan designed with the isocenter located at the target center (plan A). A second off-target isocenter plan (plan B) was generated for each case. In all plans the 100% of the prescription dose covered the 99% of the target volume. The plans A and B were compared for the target dosage (conformity and homogeneity indices) and organs at risk (OAR) dose sparing. Peripheral dose falloff was compared by using the metrics V12 (volume of normal brain receiving more than 12 Gy) and CI 50% (conformity index at the level of the 50% of the prescription dose).

Results: The values found for each metric (plan B vs. plan A) were (mean ± SD): CI (1.28 ± 0.15 vs. 1.28 ± 0.15, p = 0.978), HI (1.29 ± 0.14 vs. 1.34 ± 0.17, p = 0.079), maximum dose to brainstem (2.95 ± 2.11 vs. 2.89 ± 1.88 Gy, p = 0.813); maximum dose to optical pathway (2.65 ± 4.18 vs. 2.44 ± 4.03 Gy, p = 0.195) and maximum dose to eye lens (0.33 ± 0.73 vs. 0.33 ± 0.53 Gy, p = 0.970). The values of the peripheral dose falloff were (plan B vs. plan A): V12 (5.98 ± 4.95 vs. 6.06 ± 4.92 cm3, p = 0.622), and CI 50% (6.08 ± 2.77 vs. 6.28 ± 3.01, p = 0.119).

Conclusion: The off-target isocenter solution resulted in dosimetrically comparable plans as the center-target isocenter technique, by avoiding the risk of gantry-couch collision during the CBCT acquisition.

EP-1657

DVH analysis automation in Tomotherapy

M.E. Perez Alvarez[1], J.C. Zapata Jiménez[1], C.B. Carrascosa Fernandez[1], J. Torres Donaire[1], J. Arjona Gutierrez[1], A. Gil Agudo[1]
[1]*Hospital General Universitario de Ciudad Real, Radiofísica y Protección Radiológica, Ciudad Real, Spain*

Purpose or Objective: The extraction of the data from DVH, with the aim of perform an analysis of a large number of patients in a research project, is a time-consuming process. Furthermore, in the case of Tomotherapy, the resolution obtained from the DVH is poor. This lack of resolution may suppose an additional source of error of this analysis. With the aim of solving these problems, we have developed an easy macro using the Microsoft Excel®, which allows performing the analysis of as many patients as you wish with a single click, improving the resolution and allowing the analysis of up to 7 structures in each histogram.

Material and Methods: a. Input data: 1. The dose range displayed on the DVH has to be the same in all patients. 2. Up to 7 structures can be chosen in each patient, and the same structure has to be identified with the same color in all the analyzed patients. The seven colors that can be chosen are red, green, blue, cyan, yellow, magenta and black. 3. Thereafter, a screenshot of the DVH has to be saved. b. Programming: Macro in ImageJ: 1. Open the DVH in RGB format image. 2. Split images on the RGB channels. 3. One image is obtained for each structure once the image subtraction has been performed, obtaining one single histogram for each structure. 4. The line tool will allow obtain either the dose reached in a given volume or the volume enclosed in an isodose. 5. The macro generates a plot profile and a list of values, which are saved in an independent .xls archive. Macro in Excel: 1. Opens the .xls files generated by the ImageJ macro. 2. Opens the .xls files. 3. Finds the maximum of every list. 4. Calculates the value of the histogram corresponding to this maximum. 5. Store this value in an .xls archive where all the data analyzed are stored.

Results: I.e., in a case of prostate cancer with seven structures under study, a total of 16 items are analyzed: PTV prostate and PTV nodes: 98% and 2% of volume. Rectum: V50, V60, V65, V70 and V75. Bladder: V65, V70, V75 and V80. Femoral head (left and right): V50 Penile bulb: V90 a. Time per patient: Manual: 10 min Macro: 30 s (time necessary for the preparation of the histogram). b. Resolution: Manual: X axis (dose): 16,95 points per Gy. Y axis (% volume): 0,37 points per 1% of volume. Macro: X axis (dose): 14,84 points per Gy. Y axis (% volume): 3,78 points per 1% of volume.

Conclusion: This new macro is a powerful and user-friendly tool designed to help the investigators to perform a quicker data analysis, allowing to perform it up to ten times faster. This is especially useful in the case of analyzing structures with multiple control points, as is the case of rectum and bladder. Likewise, the results obtained with the macro provide a better resolution than measured data, specially, in the y-axis, where the resolution may be improved about ten times. These kind of macros may be programmed to obtain data from as many patients and as many values as desired in the seven structures of the DVH.

EP-1658

Comparing of two different techniques for WBRT with SIB for patients with single brain metastasis

A. Ozen[1], H. Ozden[1], O. Demirkaya[1], K. Duruer[1], N. Coruhlu[1], E. Metcalfe[1], D. Etiz[1]
[1]*Eskisehir Osmangazi University Faculty of Medicine, Department of Radiation Oncology, Eskisehir, Turkey*

Purpose or Objective: The aim of this study was to evaluate and compare the non-coplanar IMRT and coplanar VMAT techniques for the treatment of patients with single brain metastasis and their influence on the absorbed dose by the OARs.

Material and Methods: Treatment planning computed tomography (CT) scans of 6 patients with single brain metastasis who had received palliative whole brain radiotherapy (WBRT) with simultaneous integrated boost (SIB) was recruited. Each patient re-planned with 9 fields non-coplanar IMRT and coplanar VMAT for dosimetric comparison. Details of the field arrangement in IMRT plan are presented in Table 1. Two coplanar full arcs by Varian Millennium 120 MLCs were used in all VMAT plans. Arcs were arranged with 30 degrees collimator to protect MLC leak. Prescribed WBRT dose was 30 Gy in 10 fractions and SIB dose was 39 Gy in 10 fractions. Radiation doses to OARs and targets, conformity and homogeneity index and monitor units from two techniques were tested statistically by pared t-test considering significant level of p-value <0.05.
Table 1. Details of the field arrangement for non-coplanar IMRT

Beam	Gantry Angle	Collimator Angle	Couch Angle
1	10	45	0
2	60	45	0
3	130	45	0
4	170	45	0
5	220	45	0
6	270	45	0
7	320	45	0
8	290	0	90
9	330	0	90

Results: Median PTV30 and PTV39 was 1390 (range: 1110-1810) and 18.3 (range: 2.9-45.6) cc. Radiation doses to both eyes were significantly higher in coplanar VMAT technique (p<0.05) (Table 2). There was no significant dose difference for both lens and targets between both techniques. Monitor unit was significantly higher in IMRT technique (median: 2076 (range: 1759-2201) vs. 617 (range: 584-695), p<0.001).
Table 2. Dose result comparisons of non-coplanar IMRT and coplanar VMAT

	IMRT	ARC	
	Median (Range)	Median (Range)	p
Eye L maximum dose (Gy)	12.36 (8.30-15.70)	14.86 (13.22-17.73)	<0.05
Eye L mean dose (Gy)	5.34 (4.42-6.40)	7.83 (7.27-9.66)	<0.05
Eye R maximum dose (Gy)	11.53 (7.20-14.94)	14.81 (13.85-17.35)	<0.05
Eye R mean dose (Gy)	5.91 (4.33-6.60)	7.97 (7.66-9.02)	<0.05
Monitor Unit	2076 (1759-2201)	617 (584-695)	<0.001

Conclusion: Non-coplanar IMRT is superior to coplanar VMAT in sparing eye without of any worse results on targets. But, negative aspects of non-coplanar IMRT technique such as duration of treatment as a result of high MU values, can affect significantly negative in routine practice.

EP-1659

Is VMAT better than field-in-field technique in simultaneous integrated boost for breast cancer?

H.H. Lee[1], C.H. Chen[1], Y.W. Hsieh[2], S.H. Hung[2], C.J. Huang[1]
[1]*Kaohsiung Medical University Hospital, Radiation Oncology, Kaohsiung, Taiwan*
[2]*Antai Tian-Sheng Memorial Hospital, Radiation Oncology, Pingtung, Taiwan*

Purpose or Objective: This study investigated conformation number (CN), homogeneity index (HI), and doses to heart, ipsilateral lung, contralateral lung and breast from two distinct radiotherapy techniques for early left-sided breast cancer patients after lumpectomy. We compared volumetric modulated arc therapy (VMAT) and field-in-field (FiF). Both technique utilized hypofractionation with simultaneous integrated boost (SIB).

Material and Methods: From archival CT scans, we selected 7 situations: 4 tumor locations in upper-outer quadrant (the most common), 1 in upper-inner quadrant, 1 in lower-outer quadrant, and 1 in lower-inner quadrant. SIB provided differential dosing to the whole breast and the resection cavity at each fraction; hence reduced the number of treatment fractions. In both VMAT and FiF, fractionation schemes were 28 daily fractions of 1.8 Gy to the whole breast and 2.15 Gy to the tumor bed adding up to a total dose of 60.2 Gy. They were biologically equivalent to the sequential boost-technique comprising 25 fractions of 2 Gy to the whole breast PTV followed by a boost irradiation in 6 fractions, using an alpha/beta ratio of 4 Gy for tumor response, based on the linear-quadratic cell survival model. Planning target volume (PTV)-breast and PTV-boost were defined by expanding whole breast isotropically by 5 mm and 3 mm, respectively. Dose volume constraints for ipsilateral lung: V20Gy < 20%, V5Gy < 40%; for contralateral lung: V5<5%; for contralateral breast: mean dose <3 Gy; for the heart: mean dose<10Gy and V20Gy < 15%. The goal was to encompass the PTV in all direction with the 95% isodose line, and volumes receiving higher than 110% of the prescribed dose were minimized. One experienced VMAT planner developed all VMAT plans while the other experienced FiF planner developed all FiF plans. The optimal CN is 1 since CN=(TV95%/TV)x(TV95%/V95%). The optimal HI is 0 since HI=(D2%-D98%)/D. CN, HI, and doses to normal tissues were compared by the Wilcoxon signed-rank test.

Results: VMAT significantly improved both CN for PTV-boost (0.66 vs. 0.29) and PTV-breast (0.82 vs 0.55), HI for PTV-breast (25.01 vs 32.54), mean dose to heart (4.08 vs 7.71), V20-heart (3.14 vs 13.12), V20-left lung (11.49 vs 24.29) and V5-left lung (31.54 vs 35.98), p = 0.018. The mean healthy breast dose was similar between VMAT and FiF (2.39 and 1.68 Gy, respectively); and the HI for PTV-Boost was also similar between VMAT and FiF (10.95 and 13.72, respectively). However, FiF did better in sparing contralateral lung. The mean dose to contralateral lung by VMAT and FiF were 1.75 Gy vs 0.46 Gy, respectively (p = 0.018).

Conclusion: VMAT significantly improved conformity and homogeneity in hypofractionated SIB plans for breast cancer. Doses to heart and ipsilateral lung were significantly decreased, yet more contralateral lung received low doses that less than 2 Gy averagely. Doses to contralateral breast showed no difference between VMAT and FiF.

EP-1660

VMAT planning and delivery for total marrow irradiation

S. Houghton[1]
[1]*The Harley Street Cancer Centre, Medical Physics, London, United Kingdom*

Purpose or Objective: To develop a volumetric arc therapy (VMAT) technique for delivering Total Marrow Irradiation (TMI) treatments at this institution using RapidArc™; to assess its benefits over the standard parallel-opposed technique, and evaluate the feasibility of delivering it.

Material and Methods: 5 previously treated TMI patients were retrospectively planned with RapidArc™. The treatments were delivered as quality assurance (QA) plans and verified using the Octavius™ phantom and PTW™ 2D array. The conventional parallel-opposed technique was modelled in the Eclipse™ Treatment Planning System and the dose distributions compared with the RapidArc™ plans.

Results: The VMAT plans were highly conformal, demonstrating significant dose reductions to organs at risk (OAR). The average median dose to the OARs with VMAT was 5.4Gy±1.3 and ranged from 2.8Gy in the oral cavity to 8.1Gy in the spleen. These are gains of between 25% and 73% compared to the conventional parallel-opposed technique which had an average median dose of 11.6±0.2. Target coverage was similar between the two plans with a D99 of 10.7Gy±0.4 for conventional TMI and 10.8±0.2Gy for VMAT TMI. The VMAT TMI plans had slightly higher global maximums than the parallel opposed plans: 13.6Gy±0.1 for VMAT; 12.6Gy±0.4 for parallel-opposed. The plan verification showed good agreement between the Eclipse distributions and measured data. The study gamma analysis pass rate averaged 99.0 ± 0.5 for all anatomical regions and plans.

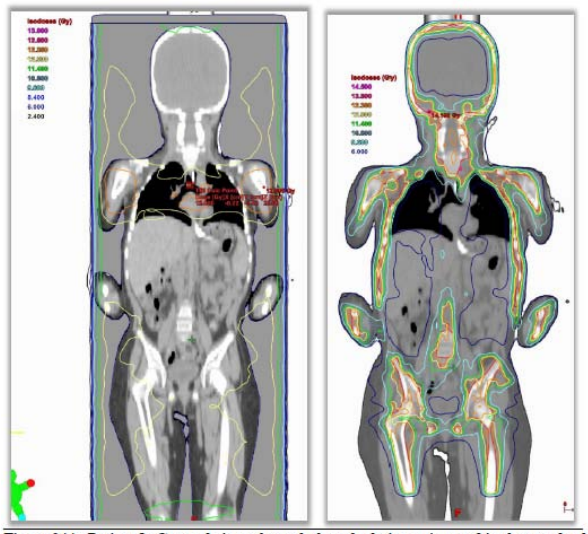

Figure 24A: Patient 1: Coronal views through the calculation point used in the standard technique showing increased target conformality and OAR sparing with RapidArc (right) compared to the standard technique (left). Note the high dose to the lung region adjacent to the calculation point in the standard plan (left).

Conclusion: VMAT planning for TMI has the potential to significantly reduce doses to OARs, thereby increasing the therapeutic ratio, and giving the potential for dose escalation. The verification process confirmed good agreement between calculated and measured data. VMAT TMI is a technically feasible alternative to the standard TMI technique but further evaluation is required before clinical implementation.